

# RESERVE COPY

## PATENT SPECIFICATION



DRAWINGS ATTACHED

Inventors: GEOFFREY LIGHT WILDE and  
JAMES OSWALD MORTLOCK

Date of filing Complete Specification: Jan. 1, 1960.

Application Date: Jan. 8, 1959. No. 728/59.

Complete Specification Published: Sept. 27, 1961.

**878472**

2

said gases transversely of the aircraft whilst said gases are being deflected by said flap members.

Preferably there are a plurality of flap members corresponding respectively to a plurality of engines, the arrangement being such that, when the flap members are in the closed position, they seal against each other and against the adjacent outer surfaces of the aircraft. Preferably there are at least four engines.

The said means may be constituted by webs provided on the flap member or

16 members.

The invention is illustrated, merely by way of example, in the drawings of which Figures 1-4 accompanied the provisional specification and Figures 5 and 6 accompany the present specification. In solid drawings:-

Figure 1 is an elevation of a vertical take-off aircraft according to the present invention, the structure of the aircraft being partly broken away to illustrate the lifting engines of the aircraft.

Figure 2 is a sectional elevation of a part of the aircraft shown in

30 Figure 1, which is a broken away section on the line 3-3 of Figure 4, illustrating the fully open position of the flap members which are disposed below the lifting engines of the aircraft according to the invention.

Figure 4 is a broken away section on the line 4-4 or Figure 3. Figure 5 is a broken away sectional view showing part of a modified vertical take-off aircraft according to the invention, and

Figure 6 is a perspective view of a flap member forming part of the construction of Figure 5.

Referring to Figures 1-4 of the drawings, a vertical take-off aircraft 10 is provided with six gas-turbine jet-reaction lifting engines 11. Alternatively the engines 11 could, if desired, be constituted by turbo-driven fans.

The upper end of the bay 12 is adapted to be opened and closed by pivotally mounted flap members 13 each individually movable between the full open position shown in Figure 2, in which the flap members 13 serve collectively to close the upper end of the bay 12, and the dotted line position shown in Figure 2, in which the flap members 13 are fully open. In the full line, or closed position, the flap members 13 are disposed in the

full line, or closed position, the flap members 13 are disposed in the

general aerodynamic profile of the aircraft and seal against each other and with the adjacent aircraft surfaces so as to prevent any ingress of air into the bay 12. The flap members 13 may also be disposed in forwardly inclined positions (not shown) so that, on forward flight of the aircraft, they serve to deflect ambient air into the intakes of the lifting engines 11, such reflection of the ambient air assisting starting of these engines, which would be tilted forward.

The lower end of the bay 12 is adapted to be opened and closed by three pivotally mounted flap members 14 which are adapted to be set in a closed position, a forwardly inclined position and any position between the closed and forwardly inclined position.

In the closed position, shown in full lines in Figure 2, the flap members 14 are disposed in the general aerodynamic profile of the aircraft and seal against each other and against the adjacent aircraft surfaces so as to prevent any ingress of air into the bay 12.

An inclined position of the flap members 14 is shown in dotted lines in Figure 2 in which the flap members 14 serve to deflect the propulsive gases from the lifting engines 11 away from the vertical so as to produce a forward component of thrust on the aircraft. It will readily be appreciated that the flap members 14 may, if so desired, be inclined forwards so that they deflect the propulsive gases forwardly whereby they produce a rearward component of thrust on the aircraft. The rear engine gas flow, in this case, does not contribute to the "braking" effect.

In the fully open position shown in Figures 3 and 4, the flap members 14 are pivotally disposed so that the propulsive gases from the engines 11 will be vertically downwardly directed.

It is preferably arranged that the intake flap members 13 and the exhaust flap members 14 are progressively opened or closed at a rate dependent upon the forward speed of the aircraft, for example the arrangement may be that the flaps will be only partially open when the forward speed of the aircraft is relatively high, the ram effect on the air being sufficient for operation of the lifting engines; the flaps will, however, be vertical when the forward speed of the aircraft falls to approximately zero, when there will be no ram effect to force the air through the engine intakes.

20 The invention concerns vertical take-off aircraft.

According to the present invention in its broadest aspect there is provided a vertical take-off aircraft having at least one lifting engine, which is mounted to discharge propulsive gases downwards, and at least one gas deflector member mounted below said engine, the gas deflector member being maintainable in a position in which it serves to deflect the downwards directed propulsive gases away from the vertical so as to produce a forward or rearward component of thrust on said aircraft, means being provided for hindering or preventing the flow of said gases transversely of the aircraft whilst said gases are being deflected by said gas deflector member.

25 In one embodiment of the present invention there is provided a vertical take-off aircraft having at least one lifting engine which is arranged to discharge propulsive gases downwards through an aperture in the aircraft structure, at least one flap member being provided which is movable into three positions, namely a closed position in which the aperture is sealed, a fully open position in which the propulsive gases may be vertically directed, and an inclined position in which the flap member serves to deflect the propulsive gases away from the vertical so as to produce a rearward component of thrust on said aircraft, means being provided for hindering or preventing the flow of the

20 flap members 14, H.A.

International Classification: B64d.

COMPLETE SPECIFICATION

Improved vertical take-off aircraft

We, ROLLS-ROYCE LIMITED, a British company of Nightingale Road, Derbyshire, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:-

10 take-off aircraft.

Vertical take-off aircraft are provided with engines (hereinafter referred to as lifting engines) which produce lift forces on the aircraft independently of lift forces which are generated aerodynamically by forward flight of the aircraft. The lifting engines are employed to effect take-off and descent of the aircraft, forward propulsion engines being employed to effect normal forward flight of the aircraft.

Thus, at take-off of the aircraft, the lifting engines are employed to lift the aircraft to a suitable altitude, after which the forward propulsion engines are brought into operation; when sufficient lift forces are generated aerodynamically by the forward flight of the aircraft the lifting engines are made inoperative.

Accordingly it may be desirable to arrange that when, on take-off, the aircraft has reached a suitable altitude, the propulsive gases discharged by the lifting engines shall be so directed as to provide a forward component of thrust on the aircraft so as to assist the forward propulsion engines. Similarly, immediately prior to descent, it may be desired that the propulsive gases discharged by the lifting engines shall be so directed as to provide a rearward component of thrust on the aircraft so as to reduce the forward speed of the

20 flap members 14, H.A.

50

55

60

65

70

75

80

85

90

95

100

105

110

115

120

125

130

135

140

145

150

155

160

165

170

175

180

185

190

195

200

205

210

215

220

225

230

235

240

245

250

255

260

265

270

275

280

285

290

295

300

305

310

315

320

325

330

335

340

345

350

355

360

365

370

375

380

385

390

395

400

405

410

415

420

425

430

435

440

445

450

455

460

465

470

475

480

485

490

495

500

505

510

515

520

525

530

535

540

545

550

555

560

565

570

575

580

585

590

595

600

605

610

615

620

625

630

635

640

645

650

655

660

665

670

675

680

685

690

695

700

705

710

715

720

725

730

735

740

745

750

755

760

765

770

775

780

785

790

795

800

805

810

815

820

825

830

835

840

845

850

855

860

865

870

875

880

885

890

895

900

905

910

915

920

925

930

935

940

945

950

955

960

965

970

975

980

985

990

995

1000

1005

1010

1015

1020

1025

1030

1035

1040

1045

1050

1055

1060

1065

1070

1075

1080

1085

1090

1095

1100

1105

1110

1115

1120

1125

1130

1135

1140

1145

1150

1155

1160

1165

1170

1175

1180

1185

1190

1195

1200

1205

1210

1215

1220

1225

1230

1235

1240

1245

1250

1255

1260

1265

1270

1275

1280

1285

1290

1295

1300

1305

1310

1315

1320

1325

1330

1335

1340

1345

1350

1355

1360

1365

1370

1375

1380

1385

1390

1395

1400

1405

1410

1415

1420

1425

1430

1435

1440

1445

1450

1455

1460

1465

1470

1475

1480

1485

1490

1495

1500

1505

1510

1515

1520

1525

1530

1535

1540

1545

1550

1555

1560

1565

1570

1575

1580

1585

1590

1595

1600

1605

1610

1615

1620

1625

1630

1635

1640

1645

1650

1655

1660

1665

1670

1675

1680

1685

1690

1695

1700

1705

1710

1715

1720

1725

1730

1735

1740

1745

1750

1755

1760

1765

1770

1775

1780

1785

1790

1795

1800

1805

1810

1815

1820

1825

1830

1835

1840

1845

1850

1855

1860

1865

1870

1875

1880

1885

1890

1895

1900

1905

1910

1915

1920

1925

1930

1935

1940

1945

1950

1955

1960

1965

1970

1975

1980

1985

1990

1995

2000

2005

2010

2015

2020

2025

2030

2035

2040

2045

2050

2055

2060

2065

2070

2075

2080

2085

2090

2095

2100

2105

2110

2115

2120

2125

2130

2135

2140

2145

2150

2155

2160

2165

2170

2175

2180

2185

2190

2195

2200

2205

2210

2215

2220

2225

2230

2235

2240

2245

2250

2255

2260

2265

2270

2275

2280

2285

2290

2295

2300

2305

2310

2315

2320

2325

2330

2335

2340

2345

2350

2355

2360

2365

2370

2375

2380

2385

2390

2395

2400

2405

2410

2415

2420

2425

2430

2435

2440

2445

2450

2455

2460

2465

2470

2475

2480

2485

2490

2495

2500

2505

2510

2515

2520

2525

2530

2535

2540

2545

2550

2555

2560

2565

2570

2575

2580

2585

2590

2595

2600

2605

2610

2615

2620

2625

2630

2635

2640

2645

2650

2655

2660

2665

2670

2675

2680

2685

2690

2695

2700

2705

2710

2715

2720

2725

2730

2735

2740

2745

2750

2755

2760

2765

2770

2775

2780

2785

2790

2795

2800

2805

2810

2815

2820

2825

2830

2835

2840

2845

2850

2855

2860

2865

2870

2875

2880

2885

2890

2895

2900

2905

2910

2915

2920

2925

2930

2935

2940

2945

2950

2955

2960

2965

2970

2975

2980

2985

2990

2995

3000

3005

3010

3015

3020

3025

3030

3035

3040

3045

3050

3055

3060

3065

3070

3075

3080

3085

3090

3095

3100

3105

3110

3115

3120

3125

3130

3135

3140

3145

3150

3155

3160

3165

3170

3175

3180

3185

3190

3195

3200

3205

3210

3215

3220

3225

3230

3235

3240

3245

3250

3255

3260

3265

3270

3275

3280

3285

3290

3295

3300

3305

3310

3315

3320

3325

3330

3335

3340

3345

3350

3355

3360

3365

3370

3375

3380

3385

3390

3395

3400

3405

3410

3415

3420

3425

3430

3435

3440

3445

3450

3455

3460

3465

3470

3475

3480

3485

3490

3495

3500

3505

3510

3515

3520

3525

3530

3535

3540

3545

3550

3555

3560

3565

3570

3575

3580

3585

3590

3595

3600

3605

3610

3615

3620

3625

3630

3635

3640

3645

3650

3655

3660

3665

3670

3675

3680

3685

3690

3695

3700

3705

3710

3715

3720

3725

3730

3735

3740

3745

3750

3755

3760

3765

3770

3775

3780

3785

3790

3795

3800

3805

3810

3815

3820

3825

3830

3835

3840

3845

3850

3855

3860

3865

3870

3875

3880

3885

3890

3895

3900

3905

3910

3915

3920

3925

3930

3935

3940

3945

3950

3955

3960

3965

3970

3975

3980

3985

3990

3995

4000

4005

4010

4015

4020

4025

4030

4035

4040

4045

4050

4055

4060

4065

4070

4075

4080

4085

4090

4095

4100

4105

4110

4115

4120

4125

4130

4135

4140

4145

4150

4155

4160

4165

4170

4175

4180

4185

4190

4195

4200

4205

4210

4215

4220

4225

4230

4235

4240

4245

4250

4255

4260

4265

4270

4275

4280

4285

4290

4295

4300

4305

4310

4315

4320

4325

4330

4335

4340

4345

4350

4355

4360

4365

4370

4375

4380

4385

4390

4395

4400

4405

4410

4415

4420

4425

4430

4435

4440

4445

4450

4455

4460

4465

4470

4475

4480

4485

4490

4495

4500

4505

4510

4515

4520

4525

4530

4535

4540

4545

4550

4555

4560

4565

4570

4575

4580

4585

4590

4595

4600

4605

4610

4615

4620

4625

4630

4635

4640

4645

4650

4655

4660

4665

4670

4675

4680

4685

4690

4695

4700

4705

4710

4715

4720

4725

4730

4735

4740

4745

4750

4755

4760

4765

4770

4775

4780

4785

4790

4795

4800

4805

4810

4815

4820

4825

4830

4835

4840

4845

4850

4855

4860

4865

4870

4875

4880

4885

4890

4895

4900

4905

4910

4915

4920

4925

4930

4935

4940

4945

4950

4955

4960

4965

4970

4975

4980

4985

4990

4995

5000

5005

5010

5015

5020

5025

5030

5035

5040

5045

5050

5055

5060

5065

5070

The flap member 14, illustrated in Figure 4 is shown as being rotatable by a control lever 15, so that it can be disposed in each of the positions referred to above. The showing of the control lever 15 is, of course, purely diagrammatic. In practice it could be arranged that all the flap members 14 are moved by means of a common control system comprising means for maintaining the flap members 14 in a selected position.

Each flap member 14 is provided with a plurality of longitudinally extending, spaced apart webs 16. The webs 16, in addition to strengthening the flap members, serve to inhibit cross flow of propulsive gases from the engines 11, that is to say flow of the propulsive gases transversely of the aircraft, for hindering or preventing the flow of said gases transversely of the aircraft whilst said gases are being deflected by said flap member.

Since both the flap members 13 and the flap members 14, when in their closed positions, seal one with another and with the adjacent aircraft surfaces, it is unnecessary to provide additional members to close the upper and lower ends of the bay 12. In figures 5 and 6 there is shown an alternative construction in which the flap members 14 are replaced by flap members 17. The flap members 17 have spaced side walls 18 between which extend an inner curved deflector 19 and an outer curved deflector 20, the deflectors 19, 20 being spaced from and parallel to each other.

One of the ends 21 of each flap member 17 is smoothly curved, the deflector 19 constituting a smooth continuation of the end 21. The end 21 has a hole 22 therethrough which receives a pivot pin 23, the pin 23 being carried by a bar 24 mounted (by means not shown) within the bay 12. The flap members 17 are movable in the same way as the flap members 14, so as to deflect the propulsive gases from the lifting engines 11. The provision of the two spaced, curved deflectors 19, 20 assists in the smooth deflection of the propulsive gases into the desired direction.

**WHAT WE CLAIM IS:-**

- A vertical take-off aircraft having at least one lifting engine, which is mounted to discharge propulsive gases downwardly, and at least one gas deflector member mounted below said engine, the gas deflector member being maintainable in a position whereby

downwardly directed propulsive gases away from the vertical so as to produce a forward or rearward component of thrust on said aircraft, means being provided for hindering or preventing the flow of said gases transversely of the aircraft, whilst said gases are being deflected by said gas deflector member.

2. A vertical take-off aircraft having at least one lifting engine, which is mounted to discharge propulsive gases downwardly, and at least one gas deflector member mounted below said engine, the gas deflector member being maintainable in a position whereby

downwardly directed propulsive gases away from the vertical so as to produce a forward or rearward component of thrust on said aircraft, means being provided for hindering or preventing the flow of said gases transversely of the aircraft, whilst said gases are being deflected by said gas deflector member.

3. An aircraft as claimed in Claim 2 in which the flap members 18 are movably mounted at the upper and lower ends of the bay 12, the flap members 18 being spaced from and parallel to each other.

4. An aircraft as claimed in Claim 2 or 3, in which there are at least four flap members corresponding respectively to a plurality of engines, the arrangement being such that, when the flap members are in the closed position, they seal against each other and against the adjacent outer surfaces of the aircraft.

5. An aircraft as claimed in any of Claims 2 to 4 in which the said means are constituted by webs provided on the flap member or members.

6. An aircraft as claimed in any of claims 2-6 in which each of the flap members comprises at least one curved deflector member for deflecting the said propulsive gases.

7. An aircraft as claimed in Claim 6 in which each flap member is provided with two spaced curved deflector members.

8. An aircraft as claimed in any of Claims 2-8 in which the upper end of the bay is provided with flap members which are movable between an open position and a position in which they collectively close the said upper end.

10. An aircraft as claimed in

provisional specification or Figures 6 and 6 of the accompanying drawings.

J. MILLER & CO.,

Chartered Patent Agents,  
Bank Chambers,  
329 High Holborn,  
London, W.C.1.

### PROVISIONAL SPECIFICATION

No. 728 A.D. 1959

#### Improved vertical take-off aircraft

components of thrust may be produced. According to the present invention

In its broadest aspect there is provided a vertical take-off aircraft having at least one lifting engine, which is mounted to discharge propulsive gases downwardly, and at least one gas deflector member mounted below said

engine, the gas deflector member being maintainable in a position in which it serves to deflect the downwardly directed propulsive gases away from the vertical so as to produce a forward or rearward component of thrust on said aircraft.

Vertical take-off aircraft are provided with engines (hereinafter referred to as lifting engines) which produce lift forces on the aircraft independently of lift forces which are generated aerodynamically by forward flight of the aircraft. The lifting engines are employed to effect take-off and descent of the aircraft, forward propulsion engines being employed to effect normal forward flight of the aircraft.

Thus, at take-off or the aircraft, the lifting engines are employed to lift the aircraft to a suitable altitude, after which the forward propulsive engines are brought into operation, when sufficient lift forces are generated aerodynamically by the forward flight of the aircraft the lifting engines are made inoperative.

Accordingly it may be desirable to arrange that when, on take-off, the aircraft has reached a suitable altitude, the propulsive gases discharged by the lifting engines shall be so directed as to assist the forward propulsion engines. Similarly, immediately prior to descent, it may be desired that the propulsive gases discharged by the lifting engines shall be so directed as to provide a rearward component of thrust

on said aircraft.

Preferably there are a plurality of flap members corresponding respectively to a plurality of engines, the arrangement being such that, when the flap members are in the closed position,

Means are preferably provided for hindering or preventing flow of propulsive gases transversely of the aircraft. Thus the said means may be constituted by webs provided on the flap member or members.

The invention is illustrated, merely

Claim 9 in which the flap members at the upper end of the bay are positionable in an inclined position such that, on forward flight of the aircraft, they serve to deflect ambient air into the intake or intakes of any engines in said bay.

11. An aircraft substantially as described with reference to and as shown in Figures 1-4 of the

10. An aircraft substantially as described with reference to and as shown in Figures 1-4 of the

#### PROVISIONAL SPECIFICATION

No. 728 A.D. 1959

#### Improved vertical take-off aircraft

components of thrust may be produced. According to the present invention

In its broadest aspect there is provided a vertical take-off aircraft having at least one lifting engine, which is mounted to discharge propulsive gases downwardly, and at least one gas deflector member mounted below said

engine, the gas deflector member being maintainable in a position in which it serves to deflect the downwardly directed propulsive gases away from the vertical so as to produce a forward or rearward component of thrust on said aircraft.

Vertical take-off aircraft are provided with engines (hereinafter referred to as lifting engines) which produce lift forces on the aircraft independently of lift forces which are generated aerodynamically by forward flight of the aircraft. The lifting engines are employed to effect take-off and descent of the aircraft, forward propulsion engines being employed to effect normal forward flight of the aircraft.

Thus, at take-off or the aircraft, the lifting engines are employed to lift the aircraft to a suitable altitude, after which the forward propulsive engines are brought into operation, when sufficient lift forces are generated aerodynamically by the forward flight of the aircraft the lifting engines are made inoperative.

Accordingly it may be desirable to arrange that when, on take-off, the aircraft has reached a suitable altitude, the propulsive gases discharged by the lifting engines shall be so directed as to assist the forward propulsion engines. Similarly, immediately prior to descent, it may be desired that the propulsive gases discharged by the lifting engines shall be so directed as to provide a rearward component of thrust

on said aircraft.

Preferably there are a plurality of flap members corresponding respectively to a plurality of engines, the arrangement being such that, when the flap members are in the closed position,

Means are preferably provided for hindering or preventing flow of propulsive gases transversely of the aircraft. Thus the said means may be constituted by webs provided on the flap member or members.

The invention is illustrated, merely

1. A vertical take-off aircraft having at least one lifting engine, which is mounted to discharge propulsive gases downwardly, and at least one gas deflector member mounted below

80 which it serves to deflect the said engine, the gas deflector member being maintainable in a position whereby

80 the above-mentioned forward or rearward

10. An aircraft as claimed in

130

by way of example, in the accompanying drawings in which:-

Figure 1 is an elevation of a vertical take-off aircraft according to the present invention, the structure of the aircraft being partly broken away to illustrate the lifting engines of the aircraft.

Figure 2 is a sectional elevation 10 of a part of the aircraft shown in Figure 1.

Figure 3, which is a broken away section on the line 3-3 of Figure 4, illustrates the fully open position 16 of the flap members which are disposed below the lifting engines of the aircraft according to the invention, and

Figure 4 is a broken away section on the line 4-4 of Figure 5. Referring to the drawings, a vertical take-off aircraft 10 is provided with six gas-turbine jet-reaction lifting engines 11 arranged in an engine bay 12. Alternatively the engines 11 could, if desired, be constituted by turbo-driven fans.

The upper end of the bay 12 is adapted to be opened and closed by pivotally mounted flap members 13 each of which is movable between the full line position shown in Figure 2, in which the flap members 13 serve collectively to close the upper end of the bay 12, and the dotted line position shown in Figure 2, in which the flap members 13 are fully open. In the full line, or closed position, the flap members 13 are disposed in the general aerodynamic profile of the aircraft and seal against each other and with the adjacent aircraft surfaces so as to prevent any ingress of air into the bay 12. The flap members 13 may also be disposed in forwardly inclined positions (not shown) so that, on forward flight of the aircraft, they serve to deflect ambient air into the intakes of the lifting engines 11, such deflection of the ambient air assisting starting of these engines, which would be tilted forward.

The lower end of the bay 12 is adapted to be opened and closed by three pivotally mounted flap members 14 which are adapted to be set in a closed position, a forwardly inclined position and any position between the closed and forwardly inclined position.

In the closed position, shown in full lines in Figure 2, the flap members 14 are disposed in the general aerodynamic profile of the aircraft and seal against each other and against the adjacent aircraft surfaces so

as to prevent any ingress of air into the bay 12.

An inclined position of the flap members 14 is shown in dotted lines in Figure 2 in which the flap members 14 serve to deflect the propulsive gases from the lifting engines 11 away from the vertical so as to produce a forward component of thrust on the aircraft. It will readily be appreciated that the flap members 14 may, if so desired, be inclined forwards so that they deflect the propulsive gases forwardly whereby to produce a rearward component of thrust on the aircraft. The rear engine gas flow, in this case, does not contribute to the "braking" effect.

In the fully open position, shown in Figures 3 and 4, the flap members 14 are vertically disposed so that the propulsive gases from the engines 11 will be vertically downwardly directed.

It is preferably arranged that the intake flap members 13 and the exhaust flap members 14 are progressively opened or closed at a rate dependent upon the forward speed of the aircraft, for example the arrangement may be such that the flaps will be only partially open when the forward speed of the aircraft is relatively high, the ram effect on the air being sufficient for operation of the lifting engines; the flaps will, however, be vertical when the forward speed of the aircraft falls to approximately zero, when there will be no ram effect to force the air through the engine intakes.

The flap member 14 illustrated in Figure 4 is shown as being rotatable by a control lever 16 so that it can be disposed in each of the positions referred to above. The showing of the control lever 16 is, of course, purely diagrammatic. In practice it could be arranged that all the flap members 14 are moved by means of a common control operable from the pilot's cabin, such control comprising means for maintaining the flap members 14 in a selected position.

Each flap member 14 is provided with a plurality of longitudinally extending, spaced apart webs 16. The webs 16, in addition to strengthening the flap members, serve to inhibit cross flow of propulsive gases from the engines 11, that is to say flow of the propulsive gases transversely of the aircraft. It is desirable to prevent such cross flows since these can cause yawing of the aircraft.

Since both the flap members 13 and the flap members 14, when in their

closed positions, seal one with another and with the adjacent aircraft surfaces, it is unnecessary to provide additional members to close the upper and lower ends of the bay 12.

J. MILLER & CO.,

Chartered Patent Agents,

Bank Chambers,  
328 High Holborn,  
London, W.C.1.

Printed in England by Her Majesty's Stationery Office - 1951.  
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2.  
free which copies may be obtained.

878,472  
6  
the bay 12.

An inclined position of the flap members 14 is shown in dotted lines in Figure 2 in which the flap members 14 serve to deflect the propulsive gases from the lifting engines 11 away from the vertical so as to produce a forward component of thrust on the aircraft. It will readily be appreciated that the flap members 14 may, if so desired, be inclined forwards so that they deflect the propulsive gases forwardly whereby to produce a rearward component of thrust on the aircraft. The rear engine gas flow, in this case, does not contribute to the "braking" effect.

In the fully open position, shown in Figures 3 and 4, the flap members 14 are vertically disposed so that the propulsive gases from the engines 11 will be vertically downwardly directed.

It is preferably arranged that the intake flap members 13 and the exhaust flap members 14 are progressively opened or closed at a rate dependent upon the forward speed of the aircraft, for example the arrangement may be such that the flaps will be only partially open when the forward speed of the aircraft is relatively high, the ram effect on the air being sufficient for operation of the lifting engines; the flaps will, however, be vertical when the forward speed of the aircraft falls to approximately zero, when there will be no ram effect to force the air through the engine intakes.

The flap member 14 illustrated in Figure 4 is shown as being rotatable by a control lever 16 so that it can be disposed in each of the positions referred to above. The showing of the control lever 16 is, of course, purely diagrammatic. In practice it could be arranged that all the flap members 14 are moved by means of a common control operable from the pilot's cabin, such control comprising means for maintaining the flap members 14 in a selected position.

Each flap member 14 is provided with a plurality of longitudinally extending, spaced apart webs 16. The webs 16, in addition to strengthening the flap members, serve to inhibit cross flow of propulsive gases from the engines 11, that is to say flow of the propulsive gases transversely of the aircraft. It is desirable to prevent such cross flows since these can cause yawing of the aircraft.

Since both the flap members 13 and the flap members 14, when in their

878,472

COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of  
the Original on a reduced scale.

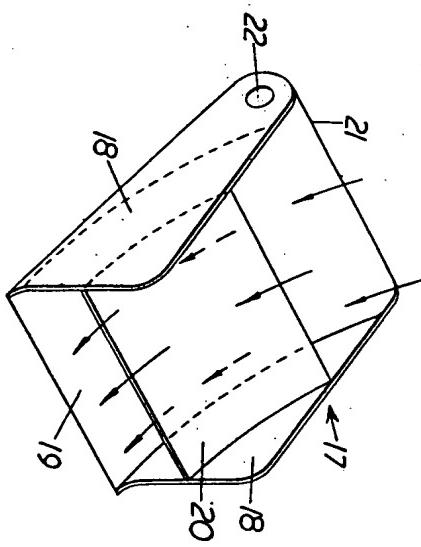
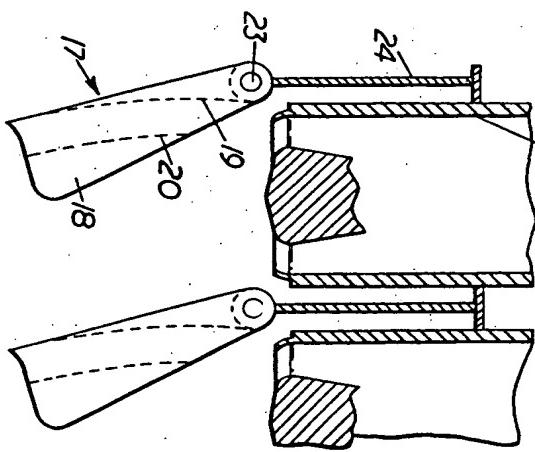


FIG. 6.



878,472 PROVISIONAL SPECIFICATION

2 SHEETS

This drawing is a reproduction of  
the Original on a reduced scale.  
SHEETS 1 & 2

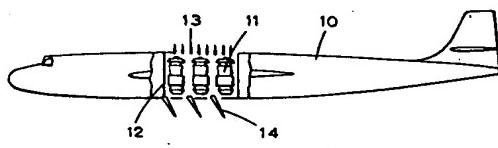


FIG. 1.

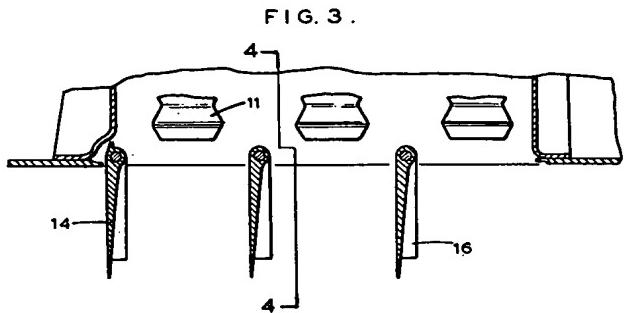


FIG. 3.

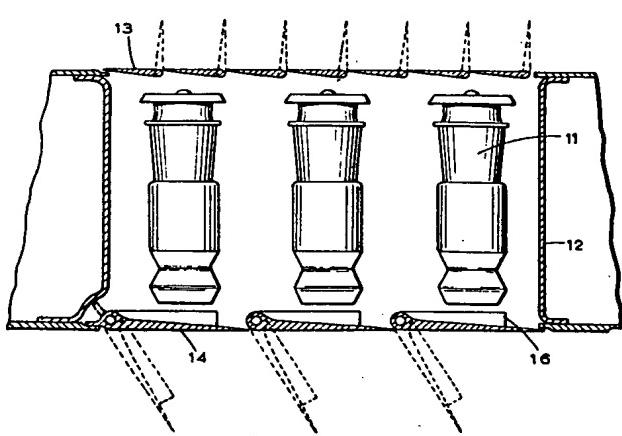


FIG. 2.

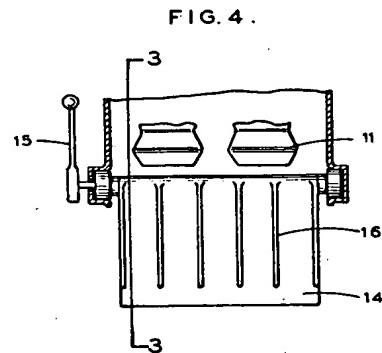


FIG. 4.